EM Engineering & Technology Roadmap

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Engineering and Technology Program

Mission

- To Identify Vulnerabilities and to Reduce the Technical Risk and Uncertainty of EM Programs and Projects

Vision

- Engineering and technology initiatives will provide the engineering foundation, technical assistance, new approaches, and new technologies that contribute to significant reductions in risk (technology, environmental, safety, and health), cost, and schedule for completion of the EM mission.

Strategic Planning for Engineering and Technology Program Activities

- Strategic Planning Approach
  - Implement Roadmap Initiatives
  - Select Critical, High-Risk, High-Payoff Projects
  - Conduct Technical Workshops and Exchanges
  - Complete External Technical Reviews
  - Review Risk Management Plans
  - Complete Technology Readiness Assessments
- Collaboration with National Laboratories, Private Sector, and Universities for innovative technologies and technical exchanges
- Work with Federal Project Directors

Draft April 2007 Roadmap Revised In September 2007

- Incorporates Stakeholder comments and adds strategies for spent nuclear fuel and nuclear materials.
- Identifies technology risks in Waste Processing, Groundwater and Soil Remediation, and Deactivation & Decommissioning/Facility Engineering.
- Establishes strategic initiatives to address technical risks and identifies expected outcomes when implemented.
- Is a living document.
- Is in concurrence.

Roadmap Implementation

- Multiyear Program Plans (MYPP) being developed to implement Roadmap.

- Staff from National Laboratories across the DOE complex has been involved in formulating the Engineering and Technology MYPP.

- MYPP will address:
  - prioritized work activities, required budget, schedule, major products/deliverables, performance metrics, and performer selection
  - Draft MYPP due this month
  - Final MYPP will be completed in Second Quarter FY2008

Reducing Risks through Technology Demonstrations and Deployments

- EM has been demonstrating and deploying innovative and cost-effective technologies.
- Non-Destructive Examination and Non-Destructive Assay technologies for large transuranic (TRU) waste containers.
- Removal of aluminum, chromium, and strontium from waste.
- Cleanup of Chlorinated Solvents.
- Real Time Radiation Monitoring.

Reducing Risks through Technology Demonstrations and Deployments: Demonstration of Private Sector Technologies will Build on the Successful ART Process

- DOE announced in September 2007 the 5 Phase II efforts for the Advanced Remediation Technologies projects with private industry "to demonstrate and implement processes to accelerate high-level waste (HLW) and groundwater/soil cleanup missions across the Department's complex."
- 12 Phase I projects were funded
  - 4 small businesses and 1 university
  - 9 HLW projects and 3 Groundwater/Soils
- 5 longer-term Phase II Projects were awarded on 9/25/07; 4 address HLW technology needs and 1 focuses on groundwater remediation
- These private sector activities send the clear message that EM will use both internal and external capabilities to best meet needs of the EM mission.

Reducing Risks through Technology Demonstrations and Deployments: Advanced Remediation Technology (ART) Phase II Awards

AREVA – Cold Crucible Induction Melting (CCIM)

- CCIM utilizes higher operating temperatures that will enable increased waste loading and result in fewer canisters produced.
- May accelerate the high level waste vitrification program schedule, reduce life cycle costs, and mitigate technical risks at Savannah River.

THOR Treatment Technologies – Steam Reforming

- Complement treatment of Low Activity Waste that is planned for bulk vitrification at Hanford.
- Monolithic waste form that meets all waste disposal requirements.

Parsons Corporation – Near Tank Cesium Removal Using Advanced Ion Exchange

- Enables removal of cesium from Hanford tank supernates and dissolved saltcake using a portable, modular, shielded, near-tank system.

Parsons Corporation – Near Tank Continuous Sludge Leaching to Remove Aluminum and Chromium from High-Level Waste

- Leaching technology to dissolve aluminum and chromium contained in Hanford sludge to remove the metals and reduce the high-level waste volume requiring vitrification.

Arcadis – Enhanced Anaerobic Reductive Precipitation / Enhanced Reductive Dechlorination

- In-situ bioreductive process to immobilize contaminant metals and radionuclides within the subsurface at Hanford.
- Injection of a biodegradable substrate into the subsurface to stimulate native microorganisms that will couple the oxidation of the degradable substrate.

External Technical Reviews: a Tool to Look at Risks and Uncertainties

- External Technical Reviews (ETRs) support EM projects in addressing their risks and uncertainties
- Engineering and Technology Office work with Federal Project Directors to put together ETR charters and lines of inquiry using subject matter experts; specific guidance to be issued shortly.
- Completed ETRs include:
  - ORP Waste Treatment Plant
  - SRS Tank 48
  - SRS Salt Waste Processing Faciltiy
  - Hanford Environmental Restoration Disposal Facility (ERDF)
  - ORP Fractional Crystallization Pilot Plant Design and Testing
  - Paducah Remedial Design Review
  - Richland Remedial Design Review
  - Arrowpak TRU Container Review

Example of Results from External Technical Reviews

- WTP at Hanford report issued 3/17/06; examined issues related to current flowsheet, identified one issue that could prevent plant operation (line plugging).
- Tank 48 at SR report issued 8/10/06; assessed the viability of preferred path forward in disposition of tetraphenylborate, confirmed steam reforming as preferred technology.
- DBVS at Hanford report issued 9/28/06; reviewed status of DBVS program in meeting program objectives, no fatal flaws identified.
- SWPF at SR report issued on 11/22/06; focused on determination if design was technically sufficient to support development of baseline cost and schedule, found that project ready for CD-2 review.
- Remediation systems at Hanford for ZP-1 Operable Unit; evaluation of existing remedial systems will support Feasibility Study for Record of Decision.

External Technical Reviews Path Forward

- Incorporate Lessons Learned and Response Plans into EM projects
- Identify common issues and concerns for technical exchange workshops
  - Cementitious Materials and Aluminum/Chromium Workshops held in early 2007.
  - Technical exchanges among Savannah River, Idaho, and Hanford on waste processing projects held March 2007 and October 2007.
  - In-situ Decommissioning Workshop held September 2007.
- Establish an ETR Guidance Manual
  - Currently being developed
- Communicate with Federal Project Directors to identify ETRs and technical exchanges to support EM Projects' Critical Decisions

Sharing Technical Expertise and Lessons Learned to Reduce Risks and Technical Uncertainties

- Technology Exchange meetings have assured maximum benefits from outcomes of R&D performed across the DOE complex
- Focused workshops
  - Cementitious Workshop, December 2006
  - Aluminum/Chromium Workshop, January 2007
  - In-situ Decommissioning Workshop, September 2007
- Common Issues teleconferences have shared technical design, construction and operational experiences of mutual interest to EM waste projects
  - Cross Flow Filter Testing – sharing of test information among sites
  - Cesium Ion Exchange Research – future benefit to multiple sites
  - Technology Readiness Assessments – input for process development
  - Pulse Jet Mixers Erosion Wear – improving the testing parameters
  - Fire Resistant Structural Design – lessons learned in design
  - Waste Transport and Pipe Plugging - lessons learned from operations

Measuring Technology Maturity of EM Projects Will Assure Their Advancement

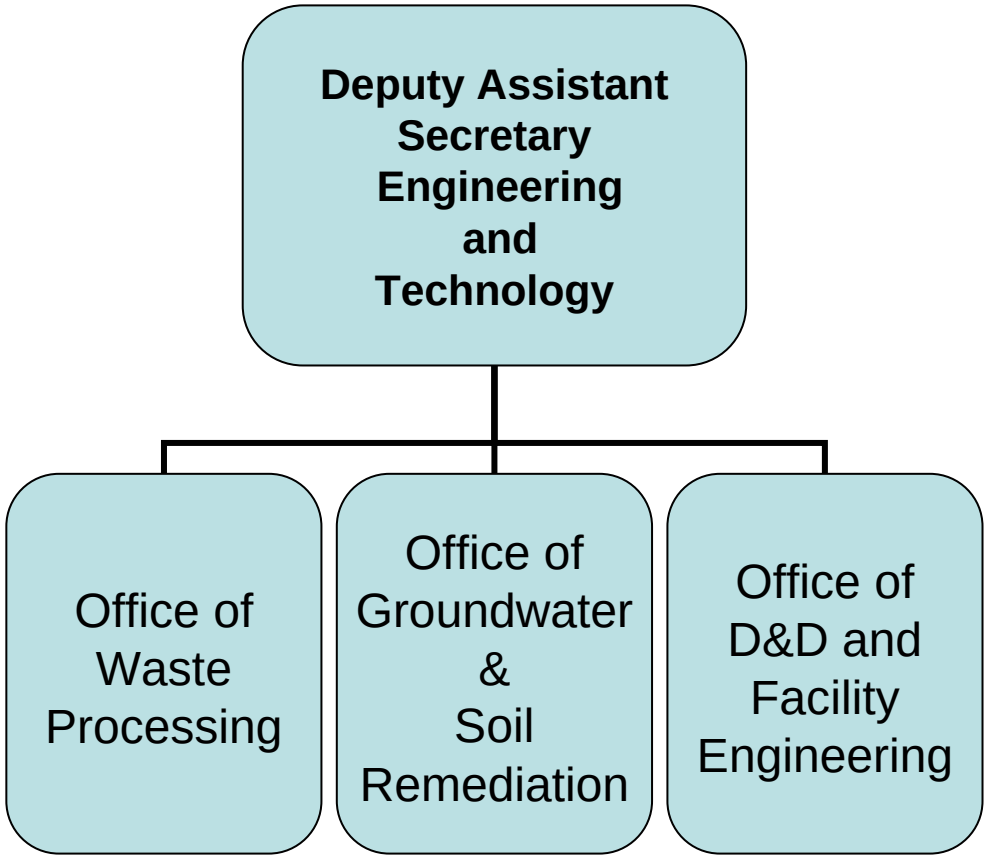
- "GAO … [recommends improving] DOE's oversight of major construction projects by developing comprehensive standards for measuring and communicating the readiness of project technologies. In developing these standards, DOE should consider lessons learned from [NASA and DoD], as well as DOE's limited experience in measuring technology readiness." [ref. GAO-07-336, (March 2007)]
- Technology Readiness Assessments (TRAs) are designed after the approach used by NASA and DoD to measure the technology maturity of projects; pilot applications of this approach have yielded valuable insights, focused efforts, improved reliability, which will help advance their use. Draft guidance being prepared on the TRA process (how they are coordinated, conducted, and reported).
- Draft report language from the House, if approved, would make such reviews a requirement:
  - "The Committee directs that the Department incorporate the GAO's technology readiness recommendations into the management of all EM projects."

Conclusions

- Roadmap identifies strategies to reduce risks and improve technologies and processes at EM sites.
- External Technical Reviews have been proven useful in supporting critical project management decisions.
- Project Risk Management Plans should be used to help resolve technical risks and uncertainties.
- Technology Readiness Assessments are a promising tool to delineate technical risk. Technology Maturity Plans are key to reducing project risk.
- Better communication is needed to ensure project success.

BACKUP CHARTS

EM Office of Engineering and Technology

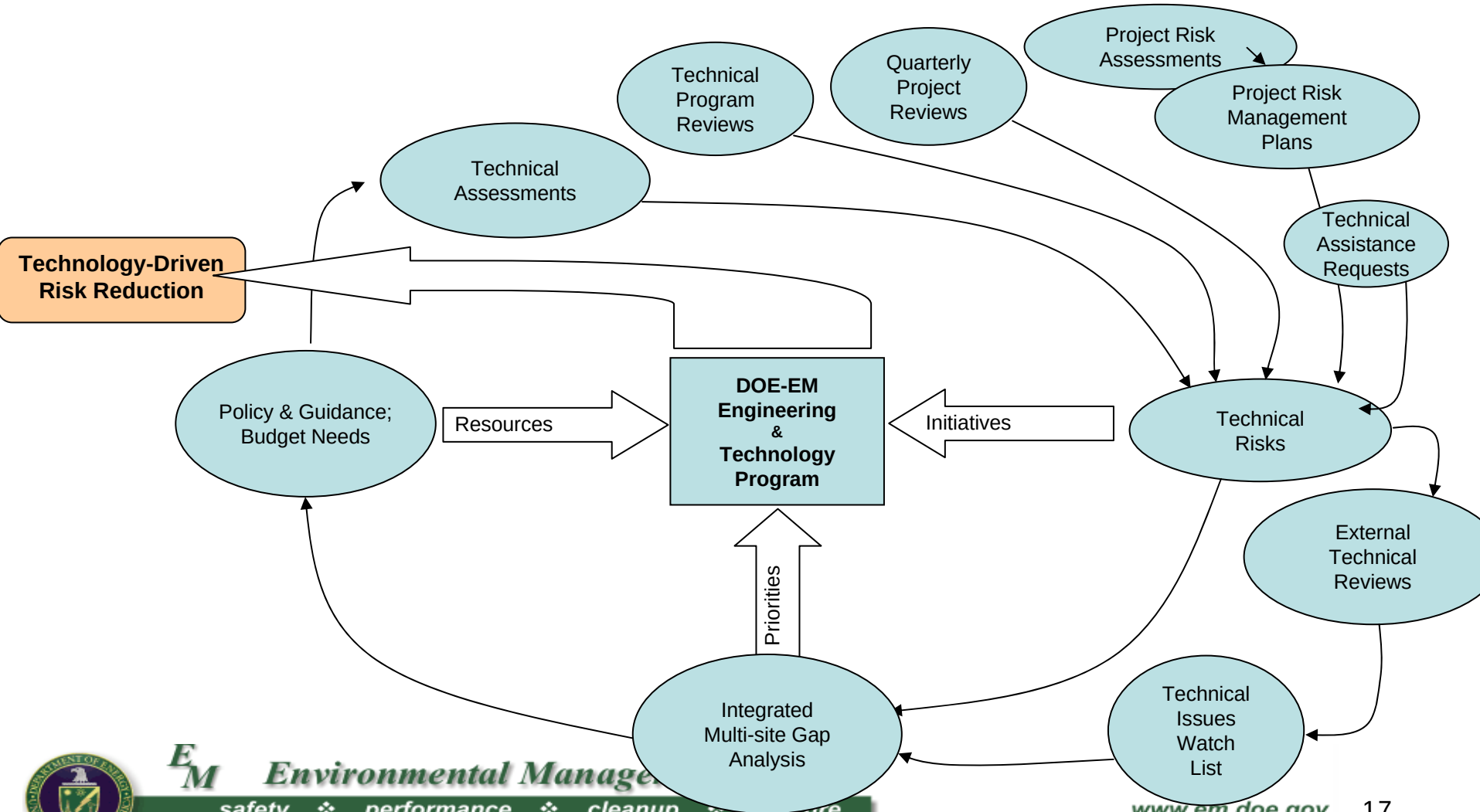


Established to Reduce Technical Risk and Uncertainty in the EM Program

Functions

- Develop policy and guidance
- Assess projects and programs through technical reviews and oversight
- Provide technical assistance and support to the field and other Headquarters offices
- Manage the EM Technology, Development and Deployment Program

Engineering & Technology Program Integration



Waste Processing Risks & Strategic Initiatives

Technical Risk and Uncertainty

--Waste Storage

- Existing tanks provide limited storage and processing capacity, have exceeded their original design life, and will likely be in service for extended periods of time.
- Conservative assumptions regarding behavior of waste during storage, such as flammable gas generation, restrict operations and increase costs.

--Waste Retrieval

- Current waste removal and retrieval operations and monitoring technologies are costly, sometimes inefficient, and are limited by complicated internal tank design (e.g., obstructions) and conditions (e.g., past leak sites).

--Tank Closure

- Achieving acceptable levels of residual radioactivity in tanks and immobilization of residual material suitable for final closure has not been fully demonstrated.
- Final closure of a waste management area, including closure of ancillary equipment such as underground transfer lines and valve boxes, has not been fully demonstrated.

--Waste Pretreatment

- Achieving effective separation of low- and high-level wastes (HLW) prior to stabilization requires improved, engineered waste processes and more thorough understanding of chemical behavior.

--Stabilization

- Waste loading (i.e., the amount of waste concentrated in waste containers) constraints limit the rate that HLW can be vitrified, and the tanks closed.
- Current vitrification techniques may require supplemental pretreatment to meet facility constraints.

Strategic Initiatives

--Improved Waste Storage Technology

- Develop cost effective, real-time monitoring of tank integrity and waste volumes to ensure safe storage and maximum storage capacity.
- Improve understanding of corrosion and changing waste chemistry including flammable gas generation, retention, release, and behavior to establish appropriate assumptions in safety analyses.

--Reliable & Efficient Waste Retrieval Technologies

- Develop optimization strategies and technologies for waste retrieval that to successful processing and tank closure.
- Develop a suite of demonstrated cleaning technologies that can be readily deployed throughout the complex to achieve required levels of removal.

--Enhanced Tank Closure Processes

- Improve methods for characterization and stabilization of residual materials.
- Develop cost-effective and improved materials (i.e., grouts) and technologies to efficiently close complicated ancillary systems.
- Perform integrated cleaning, closure, and capping demonstrations.

--Next-Generation Pretreatment Solutions

- Develop in- or at-tank separations solutions for varying tank compositions and configurations.
- Improve methods for separation to minimize the amount of waste processed as HLW.

--Enhanced Stabilization Technologies

- Develop next-generation stabilization technologies to facilitate improved operations and cost.
- Develop advanced glass formulations that simultaneously maximize loading and throughput.
- Develop supplemental treatment technologies.

Integration & Cross-Cutting Risks and Strategic Initiatives

Technical Risk and Uncertainty

--Assessing Long-Term Performance

- Inadequate fundamental understanding of wasteform performance and contaminant release, transport, and transformation processes result in inadequate conceptual models potentially leading to selection and design of non-optimal remedial actions.
- Inadequate long-term monitoring and maintenance strategies and technologies to verify cleanup performance could potentially invalidate the selected remedy and escalate cleanup costs.

--Transportation and Disposal Packaging

- Disposal and transportation restrictions include flammable gas limitations, material characteristics and configuration. Existing data is insufficient to quantify the effects of potential sources of hydrogen, deflagration events, degraded fuel, impurities, and other conditions for challenging materials.

Strategic Initiatives

--Enhanced Long-Term Performance Evaluation and Monitoring

- Develop increased understanding of long-term wasteform performance integrated with transport of contaminants to support broad remedial action decisions and cost-effective design and operation strategies.
- Develop and deploy cost-effective long-term strategies and technologies to monitor closure sites (including soil, groundwater and surface water) with multiple contaminants (organics, metals and radionuclides) to verify integrated long-term cleanup performance.

Challenging Materials
Risks and Strategic Initiatives

Technical Risk and Uncertainty

--Storage

- Improved inventory analyses, monitoring and storage systems are needed for unique TRU wastes and special nuclear materials.

--Stabilization and Disposition

- Some materials have no defined path for disposal in their current condition.

Strategic Initiatives

--Enhanced Storage, Monitoring and Stabilization Systems

- Develop advanced characterization, monitoring, and inventory analysis methods; and improved storage systems for multiple material forms including contaminants.
- Develop advanced flow sheets and processes for stabilization and waste form qualification.